SECTION 26 0700

INDUCTION MOTORS – 500HP AND SMALLER

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LANL MASTER SPECIFICATION

When editing to suit project, author shall add job-specific requirements and delete only those portions that in no way apply to the activity (e.g., a component that does not apply). To seek a variance from applicable requirements, contact the ESM Electrical POC.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Delete information within “stars” during editing.

Specification developed for ML-3 projects. For ML-1 / ML-2, additional requirements and QA reviews are required.

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PART 1 GENERAL

1.1 SECTION INCLUDES

A. Section includes single- and three-phase induction motors rated 500 horsepower and smaller and 600 volts and less for application on equipment provided under other sections and motors furnished loose to Project.

1.2 LANL PERFORMED WORK

A. None

1.3 ENVIRONMENTAL REQUIREMENTS

A. Provide motors capable of performing satisfactorily in the following service conditions:

1. Altitude of 7500 feet above sea level.
2. Maximum ambient temperature of 104 degrees F, 40 degrees C.
3. Minimum ambient temperature of minus 20 degrees F.
4. 24-hour average temperature not exceeding 86 degrees F.
5. Maximum solar heat gain: 110 Watts per square foot.

1.4 SUBMITTALS

A. Submit the following in accordance with Section 01 3300, Submittal Procedures:

1. Catalog Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

2. Calculations: Motor selection calculations including brake horsepower of the load, ambient temperature range at the motor location, and characteristics of moving air stream (if any) at the motor location.

3. Certification: Submit certification that motors meet specified performance, efficiency, and selection requirements.

4. Test Reports: Indicate procedures and results for specified factory testing.

5. Installation instructions including handling, storage, setting, mechanical connections, lubrication, wiring, and testing.

6. Operation and maintenance data:

a. Operation data including instructions for safe operating procedures.

b. Maintenance data including assembly drawings, bearing data with replacement sizes, and lubrication instructions.

7. Project record documents:

a. Report of field tests showing compliance with and field testing and inspection specified in Part 3 of this specification section.

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Edit the following article to match project requirements; delete if not needed. See instructions for FIELD QUALITY CONTROL article of this Section.
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b. Start-up report from motor manufacturer's service to certify that motor and accessories have been installed, adjusted, and tested in accordance with manufacturer's recommendations.

1.5 QUALITY ASSURANCE

A. Conform to requirements of the National Electrical Code.

B. Furnish products listed and labeled by a nationally recognized testing laboratory (NRTL) as suitable for purposes specified and shown.

1.6 RECEIVING, STORING AND PROTECTING

A. Receive, store, and protect, and handle products according to NECA 1—Standard Practices for Good Workmanship in Electrical Construction (ANSI), and NECA 230—Standard for Selecting, Installing, and Maintaining Electric Motors and Controllers (ANSI).

B. Upon delivery of motors to site, inspect thoroughly for damage.

C. Store, protect and handle motors following manufacturer's instructions. Provide slings and spreader bars as required. Lift only with lugs provided. Do not lift motors using shaft as an attachment point.

D. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

E. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted, follow Section 01 2500, Substitution Procedures.

2.2 MANUFACTURERS

A. Siemens

B. TECO-Westinghouse

C. Baldor

D. Marathon Electric

E. U. S. Motors

2.3 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Motors less than 250 watts for general applications may be equipment manufacturer's standard product and need not conform to these specifications.

B. Provide motors with electrical and mechanical performance in accordance with NEMA MG-1, Motors and Generators, unless specified otherwise in this Section.

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Edit the following article to match project requirements.
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C. Electrical Service:

1. 3/4 horsepower and smaller, furnish 115 volts, single phase, 60 Hz motors.

2. Greater than 3/4 horsepower, furnish [200] [230] [460] volts, 3-phase, 60 Hz motors.

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Edit the following article to match project requirements.
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D. Enclosure

1. For clean, dry, indoor locations furnish drip-proof type motors.

2. For unfiltered air stream locations in manufacturer assembled equipment furnish either totally enclosed non-ventilated (TENV) or totally enclosed fan-cooled (TEFC) type motors.

3. For [exterior locations] [damp locations] [air cooled condensers] [direct drive axial fans] [roll filters] [dust collection systems] [unfiltered air streams] [_____] furnish totally enclosed fan-cooled (TEFC) type motors.

4. For [outdoor locations] [wash down locations] [wet air streams downstream of sprayed coil dehumidifiers] [draw thru cooling towers] [humidifiers] [corrosive] [_____] furnish totally enclosed fan-cooled (TEFC) severe duty type motors.

5. For hazardous (classified) locations furnish motors approved for the particular NEC Class and Division.

6. Provide 120 volt space heaters in motors as indicated on the Drawings.

E. Rating

1. Furnish motors that are rated on a continuous-duty basis. The output rating shall be available at the shaft at the specified speed, frequency and voltage.

2. Provide motors that have been de-rated for 7500 feet altitude in accordance with NEMA MG-1. Do not use motor service factor to compensate for altitude. Refer to motor selection table below.

3. Provide motors designed for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

F. Nameplates:

1. Provide stainless steel nameplate on each motor indicating information required by ANSI/NFPA 70 and section 10.40 of NEMA MG-1.

2. Additional nameplate information may be required by other articles in this Section.

3. Attach nameplates to motor frame with stainless steel fasteners.

G. Wiring Terminations:

1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.

2. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

3. Provide a frame grounding screw or lug inside terminal cover or terminal box.

H. Furnish motors that meet NEMA MG-1-12.49 noise level standards.

2.4 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Provide single-phase power, split phase motors for applications less than 1/4 brake horsepower.

B. Furnish split phase motors that have the following characteristics:

1. Starting Torque: Less than 150 percent of full load torque.

2. Starting Current: Up to 7 times full load current.

3. Breakdown Torque: Approximately 200 percent of full load torque.

4. Insulation: Class A (50 degrees C temperature rise) or better.

5. Service Factor: Minimum of 1.35 for drip-proof motors and 1.0 for enclosed motors.

6. Bearings: Pre-lubricated ball bearings.

2.5 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Provide single-phase power, permanent split capacitor motors for shaft mounted fans or blowers 3/4 brake horsepower and smaller.

B. Permanent split capacitor motors shall have the following characteristics:

1. Starting Torque: Exceeding 1/4 of full load torque.

2. Starting Current: Up to 6 times full load current.

3. Multiple Speed: Through tapped windings.

4. Insulation: Class A (50 degrees C temperature rise) or better.

5. Service Factor: 1.0

6. Bearings: Pre-lubricated ball or sleeve bearings.

7. Integral Protection: Automatic reset overload protector.

2.6 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Provide single-phase power, capacitor start motors for applications 1/4 brake horsepower through 3/4 brake horsepower.

B. Furnish capacitor start motors that have the following characteristics:

1. Starting Torque: 3 times full load torque.

2. Starting Current: Less than 5 times full load current.

3. Pull-up Torque: Up to 350 percent of full load torque.

4. Breakdown Torque: Approximately 250 percent of full load torque.

5. Motors: Capacitor in series with starting winding. Provide capacitor-start / capacitor-run motors with 2 capacitors in parallel with run capacitor remaining in circuit at operating speeds.

6. Insulation: Class A (50 degrees C temperature rise) or better.

7. Service Factor: Minimum of 1.25 for drip-proof motors and 1.0 for enclosed motors.

8. Bearings: Pre-lubricated ball bearings.

2.7 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Provide 3-phase power, squirrel cage induction motors for applications more than 3/4 brake horsepower

B. Furnish 3-phase power, squirrel cage motors that have the following characteristics:

1. Starting Torque: NEMA Design B characteristics.

2. Starting Current: NEMA designation G, six times full load current.

3. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

4. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.

5. Insulation System: NEMA Class F or better.

6. Service Factor: 1.15 minimum.

C. Test motors in accordance with NEMA MG-1-12 and IEEE 112, IEEE Standard Test Procedure for Polyphase Induction Motors and Generators. Each motor shall receive a routine commercial test to verify freedom from electrical or mechanical defects. Provide prototype test reports for each rating.

D. Provide NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

E. For motor Frame Sizes 254T and larger provide three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter.

F. Provide grease lubricated anti-friction ball bearings, with housings equipped with provision for re-lubrication, rated for minimum ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp ANSI/AFBMA bearing identification number on motor nameplate.

G. For floor-mounted belted applications, provide an adjustable sliding base; for applications above 10 horsepower, sliding base shall have 2 adjusting bolts.

H. Provide NEMA Premium labeled motors or motors with guaranteed full-load efficiency not less than that tabulated below when tested in accordance with IEEE Std. 112, sub clause 6.4, Method B. Motor nameplates shall indicate guaranteed minimum full-load efficiency. Provide motors with nameplate horsepower matched to shaft load as tabulated below to compensate for operating altitude and to include an engineering safety factor.

MIMIMUM FULL-LOAD EFFICIENCY						
MOTOR HP	NUMBER OF POLES / SYNCHRONOUS SPEED, RPM					
	ODP MOTORS			TEFC MOTORS		
	2 3600	4 1800	6 1200	2 3600	4 1800	6 1200
1	77.0	85.5	82.5	77.0	85.5	82.5
1.5	84.0	86.5	86.5	84.0	86.5	87.5
2	85.5	86.5	87.5	85.5	86.5	88.5
3	85.5	89.5	88.5	86.5	89.5	89.5
5	86.5	89.5	89.5	88.5	89.5	89.5
7.5	88.5	91.0	90.2	89.5	91.7	91.0
10	89.5	91.7	91.7	90.2	91.7	91.0
15	90.2	93.0	91.7	91.0	92.4	91.7
20	91.0	93.0	92.4	91.0	93.0	91.7
25	91.7	93.6	93.0	91.7	93.6	93.0
30	91.7	94.1	93.6	91.7	93.6	93.0
40	92.4	94.1	94.1	92.4	94.1	94.1
50	93.0	94.5	94.1	93.0	94.5	94.1
60	93.6	95.0	94.5	93.6	95.0	94.5
75	93.6	95.0	94.5	93.6	95.4	94.5
100	93.6	95.4	95.0	94.1	95.4	95.0
125	94.1	95.4	95.0	95.0	95.4	95.0
150	94.1	95.8	95.4	95.0	95.8	95.8
200	95.0	95.8	95.4	95.4	96.2	95.8
250	95.0	95.8	95.4	95.8	96.2	95.8
300	95.4	95.8	95.4	95.8	96.2	95.8
350	95.4	95.8	95.4	95.8	96.2	95.8
400	95.8	95.8	95.8	95.8	96.2	95.8
450	95.8	96.2	96.2	95.8	96.2	95.8
500	95.8	96.2	96.2	95.8	96.2	95.8

I. Do not select motors to operate continuously above rated load in the service factor area (e.g. with a service factor greater than 1.0).

J. De-rate motors for operation at 7500 ft. altitude in accordance with the following table, taking into consideration the ambient temperature of the motor environment. Select motor based on 104 degrees F ambient temperature unless motor is in a moving air stream when operating.

Maximum Motor Shaft Load[e] (bhp)						
Motor Nameplate (hp)	Ambient Temperature[a, b, c] (deg F)					
	81.1	85	90	95	100	104[d]
1	1.00	0.98	0.95	0.92	0.89	0.87
1.5	1.50	1.47	1.43	1.38	1.34	1.31
2	2.00	1.96	1.90	1.85	1.79	1.75
3	3.00	2.93	2.85	2.77	2.68	2.62
5	5.00	4.89	4.75	4.61	4.47	4.36
7.5	7.50	7.34	7.13	6.92	6.71	6.55
10	10.0	9.78	9.51	9.23	8.95	8.73
15	15.0	14.7	14.3	13.8	13.4	13.1
20	20.0	19.6	19.0	18.5	17.9	17.5
25	25.0	24.5	23.8	23.1	22.4	21.8
30	30.0	29.3	28.5	27.7	26.8	26.2
40	40.0	39.1	38.0	36.9	35.8	34.9
50	50.0	48.9	47.5	46.1	44.7	43.6
60	60.0	58.7	57.0	55.4	53.7	52.4
75	75.0	73.4	71.3	69.2	67.1	65.5
100	100	97.8	95.1	92.3	89.5	87.3
125	125	122	119	115	112	109
150	150	147	143	138	134	131
200	200	196	190	185	179	175
250	250	245	238	231	224	218
300	300	293	285	277	268	262
350	350	342	333	323	313	305
500	500	489	475	461	447	436
450	450	440	428	415	403	393
500	500	489	475	461	447	436

Notes:

a. Select motor based on 104 degrees F ambient temperature unless motor is in a moving air stream when operating.

b. Document selection of an ambient temperature lower than 90 degrees F.

c. Do not extrapolate to ambient temperatures below 81.1 or above 104 degrees F. If the ambient temperature is outside the 81.1 °F to 104 °F range, refer to NEMA MG 1 and/or the motor manufacturer for guidance.

d. If ambient temperature exceeds 104 degrees F, select motor with greater nameplate hp rating in accordance with NEMA MG 1.

e. Motor selection criteria developed from temperature rise considerations in NEMA MG 1-2003, clauses 12.43, 12.51.2, and 14.4.

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Edit the following article to match project requirements. Coordinate with equipment schedules on the Drawings.
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K. Where indicated on Drawings, provide motors suitable for use with part winding starting systems to reduce locked rotor current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.

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Edit the following article to match project requirements. Coordinate with equipment schedules on the Drawings.
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L. Where indicated on Drawings, provide motors suitable for use in a single winding, variable torque connection for 2 speed fan and centrifugal pump applications.

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Edit the following article to match project requirements. Coordinate with equipment schedules on the Drawings.
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M. Where indicated on Drawings, provide motors suitable for use with adjustable frequency controllers as follows:

1. Provide motors that comply with Part 31 of NEMA MG-1 for use with pulse width modulation (PWM) adjustable frequency AC controllers.

2. Provide motors that comply with Part 30 or 31 of NEMA MG-1 for use with six step adjustable frequency controllers.

PART 3 EXECUTION

3.1 EXISTING WORK

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Delete this article when existing construction is not affected.
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A. Disconnect and remove abandoned motors

B. Maintain access to existing motors and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Clean and repair existing motors to remain or are to be reinstalled.

3.2 INSTALLATION

A. Install motors and accessories in accordance with manufacturer's instructions and NECA 230; have manufacturer’s installation instructions available at the construction site.

B. Remove any slushing compound on shaft or other parts using a petroleum-type solvent.

C. Remove shaft shipping braces after motor is placed in its final location.

D. Install motor securely on firm, level foundation.

E. Install shaft coupling or sheave in accordance with manufacturers instructions. Do not modify motor shaft to accommodate coupling or sheave.

F. Align the motor shaft with the load shaft. Meet the most stringent of the motor manufacturer's requirements for shaft alignment, the driven equipment manufacturer's requirements for shaft alignment, or the following requirements for shaft alignment. The minimum acceptable criteria for motor installation and shaft alignment for motors 10 horsepower and larger are as follows:

1. Load and motor casing distortion (soft foot): Not more than 0.002 inch (0.0508 mm) at each foot. Use stainless steel pre-stamped shims as required in bringing soft foot within acceptable limits.

2. Load and motor shaft runout: Not more than 0.001 inch. If load shaft exceeds criteria contact the LANL Contract Administrator. If motor shaft runout exceeds criteria, replace the motor.

3. Alignment tolerances for coupled shafts with short couplings:

Speed, rpm	SHAFT OFFSET At center, inch (mm)	ANGULARITY/GAP Inch/10 inches (mm/254 mm)
600	0.005 (0.1270)	0.010 (0.2540)
900	0.003 (0.0762)	0.007 (0.1778)
1200	0.0025 (0.0635)	0.005 (0.1270)
1800	0.002 (0.0508)	0.003 (0.0762)
3600	0.001 (0.0254)	0.002 (0.0508)
7200	0.0005 (0.0127)	0.001 (0.0254)

4. Alignment tolerances for coupled shafts having couplings with spacers:

Speed, rpm	SHAFT OFFSET Per inch (25.4 mm) of spacer length
600	0.0018 (0.0457)
900	0.0012 (0.0305)
1200	0.0009 (0.0229)
1800	0.0006 (0.0152)
3600	0.0003 (0.0076)
7200	0.00015 (0.0038)

G. For belt driven loads use string or straight edge alignment of pulley grooves to minimize offset, angle, and twist so belts are not distorted. Verify roundness of pulleys; replace pulleys with total indicator runout exceeding 0.005 inch. Set belt tension as low as possible.

H. Verify that line voltage and phases agree with motor nameplate.

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Edit the following article to match the current LANL standard specification numbers. Specifications are being updated in phases during 2003. The first section listed is the current number; the second is the intended future number.
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I. Ground motors according to manufacturer's instructions and the requirements in Section 26 0526, Grounding and Bonding for Electrical Systems.

J. Make electrical connections to motors using materials and methods specified in Sections 26 0519, Low Voltage Electrical Power Conductors and Cables and 26 0533, Raceways and Boxes for Electrical Systems. Use motor lead splicing kits to insulate and seal connections to leads.

3.3 FIELD INSPECTIONS AND TESTS

A. Verify that motor is lubricated in accordance with manufacturer's instructions.

B. Before energizing, turn motor shaft by hand to ensure free rotation.

C. Verify that the area around motor fan cooling air inlets is free of debris that could be drawn into motor or motor fan during operation.

D. Check external bolted connections for proper torque.

E. Before energizing motor with driven equipment, verify proper alignment of motor shaft with load shaft. Provide alignment test report.

F. Inspect and test motor installations in accordance with NETA ATS, except Section 4—Division of Responsibilities.

G. Perform inspections and tests listed in NETA ATS, Section 7.15.1.

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Edit the following article to match project requirements. Balance the benefits of start-up services against the cost of the motor and the importance of the load it serves. Delete the following article if the cost of the manufacturer's start-up service is not warranted.
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3.4 FIELD QUALITY CONTROL

A. For motors [100] horsepower and larger, provide services of a factory-trained manufacturer's service representative to assist in installation and start-up of equipment.

B. Perform the following work under the direction of the manufacturer's service representative:

1. Verification of proper mounting and alignment.

2. Final inspection of the lubrication system.

3. Insulation resistance test.

4. Final coupled test.

C. Provide certification that motor and accessories have been installed, adjusted, and tested in accordance with manufacturer's recommendations.

END OF SECTION

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Do not delete the following reference information:
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This project specification is based on LANL Specification 26 0700, Rev. 0, dated January 6, 2006.